

Northern bog lemming survey

1992

A Report to:

USDA Forest Service  
Kootenai National Forest  
506 U.S. Highway 2 West  
Libby, MT 59901

Submitted by:

James D. Reichel  
and  
Stan G. Beckstrom

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Montana Natural Heritage Program  
1515 E. 6th Avenue  
Helena, MT 59620

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## INTRODUCTION

The northern bog lemming (Synaptomys borealis) is a small, grayish brown, vole-like microtine, related to the true arctic lemmings (Lemmus). Nine poorly differentiated subspecies are currently recognized. The northern bog lemming has a total length of 118-140 mm including its very short tail (19-27 mm) (Banfield 1974, Hall 1981). The combination of a tail less than 28 mm and a longitudinal groove in the upper incisors distinguish the northern bog lemming from all other mice found in Montana. It is boreal in distribution, occurring in North America from near treeline in the north south to Washington, Montana, Minnesota, and New England. It typically inhabits sphagnum bogs, but is also occasionally found in mossy forests, wet sub-alpine meadows, and alpine tundra. One subspecies (S.b. artemisiae) lives on sagebrush hillsides in eastern British Columbia (Anderson 1932). Southern bog lemmings (S. copperi) also inhabit a wide variety of habitats, all of which are marginal for Microtus; bog lemmings may be competitively excluded from better quality habitats by Microtus (Doutt et al. 1973, Linzey 1981). The northern bog lemming is rarely trapped and is one of the least known mice in North America.

A few relict populations occur in the lower 48 states; the subspecies chapmani occurs in Montana, Idaho, and northeast Washington (Hall 1981). Bog lemmings are known from 4 locations in Idaho and 8 in Washington, all from within 80 km of the Canadian border (Johnson and Cheney 1953, Wilson et al. 1980, Reichel 1984,

Groves and Yensen 1989, D. Johnson pers. comm.). Prior to 1992, evidence of bog lemmings in Montana included: 1) 2-3 locations on the west side of Glacier National Park (Wright 1950, Weckwerth and Hawley 1962, Hoffmann et al. 1969); 2) Shoofly Meadows in the Rattlesnake drainage north of Missoula (Adelman 1979), and 3) a single skull recovered from a Boreal Owl (Aegolius funereus) pellet west of Wisdom (J. Jones pers. comm.); where the owl captured the lemming was unknown. The reasons for the disjunct nature of the populations may include: 1) the localized nature of its primary habitat; and 2) the currently patchy distribution of a boreal species that was more widely distributed during the Pleistocene (a glacial relict).

The U.S. Forest Service, Region 1, lists the northern bog lemming as Sensitive. The species is listed as a Species of Special Concern by the Montana (Genter 1992) and Idaho Natural Heritage Programs (Moseley and Groves 1990). S1 is defined as: "critically imperiled because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction." This has been changed to S2 following the 1992 survey. S2 is defined as "imperiled because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range."

We began a study of northern bog lemmings in Montana in 1992. Objectives the first year of the study included:

- 1) surveying at least 15 sites with potential habitat for bog

lemmings in northwest Montana, concentrating on the Kootenai National Forest;

- 2) determining efficient and effective survey techniques; and,
- 3) describing habitat where bog lemmings were found.

#### **METHODS AND MATERIALS**

We surveyed riparian habitats for bog lemmings. Most sites sampled were suggested by botanists, plant ecologists, biologists and others from the U.S. Forest Service and Montana Natural Heritage Program (MTNHP). Others were identified while in the field or by examining maps of the general areas we were to visit.

From 17 June - 21 August 1992 we used Museum Special snap-traps, Sherman live-traps, and/or pitfalls (#10 tin cans) to sample 21 sites in western Montana (Table 1). Traps were baited with a combination of peanut butter and rolled oats, either alone or with one of 5 other baits: 1) apples and carrots; 2) Hawbaker's muskrat lure; 3) Hawbaker's food lure; 4) E.J. Dailey's muskrat lure; or 5) E.J. Dailey's muskrat lure #2. Relative success of baits used was examined using the G test (Sokal and Rohlf 1969). Two traps with different baits were placed within 2 m of each other at each station. We placed each trap at a location to maximize success (runway, burrow, etc.). Stations were placed 5-20 m apart.

At sites where northern bog lemmings were not caught, trapping effort ranged from 240 to 556 trap nights over 2-4 nights. A trap night is equivalent to one trap set for one 24-hour period (traps



sprung and empty, or completely missing, are not counted). During the period 4-7 July 1992 we ran a snap trap line in a meadow and adjacent forested area located along Sunday Creek. Portions of this trap line were picked up when a bog lemming was captured. At subsequent sites, all traps were removed when the first bog lemming was captured.

Following the initial capture of northern bog lemmings at Sunday Creek, we set up a 9x9 live trap grid with 15 m spacing. Two Sherman live traps were set at each station and baited with peanut butter and oatmeal; one of the traps at each station had E.J. Dailey's muskrat lure added to the peanut butter and oatmeal. Within the live trap grid, a 5x5 pitfall grid was established with approximately 15 m spacing (Figure 1). All traps (including pitfalls) contained cotton or polyester batting for nesting material. Traps were checked twice daily. All mice caught were toe clipped with individual combinations, weighed, measured, examined for reproductive status, and released. The first trial of this live-trap grid was run from 21-24 July 1992 (pitfalls were run from 22-24 July). The grid was run again on 17-21 August 92. During the second period, traps were baited with peanut butter and oatmeal; one trap at each station had E.J. Dailey's muskrat lure added to the peanut butter and oatmeal, the other trap had E.J. Dailey's muskrat lure #2 added (peanut butter : oatmeal : lure = 30:20:1).

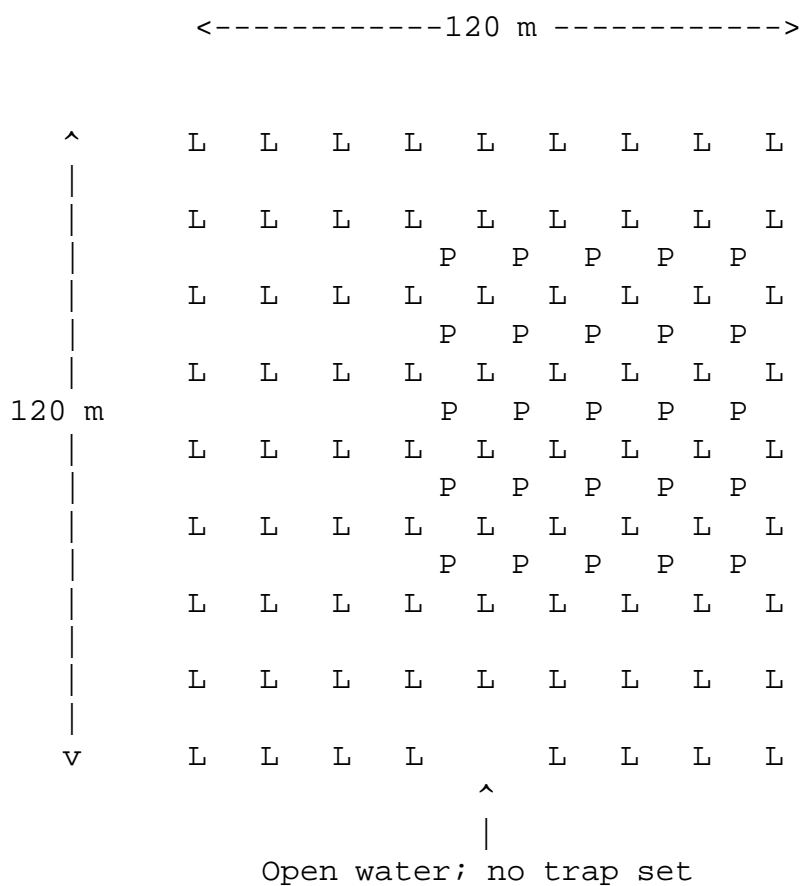
Table 1. Sites trapped during 1992 northern bog lemming surveys.

Site	Elev.	Date	Trap nights		
			snap	live	pit
KOOTENAI NATIONAL FOREST					
Fortine District					
#*Sunday Creek, Lincoln Co.	T32N R26W S13	4800	4-7 July	361	
"			21-24 July		477 50
"			17-21 Aug	638	100
#Twin Meadows Creek, Lincoln Co.	T32N R26W S20	3900	3-7 July	428	
#Dudley Slough, Lincoln Co.	T34N R26W S14	3400	30 Jun-4 Jul	387	
#Ant Flats, Lincoln Co.	T34N R25W S7	3020	30 Jun-4 Jul	288	
#Jumbo Lake, Lincoln Co.	T34N R25W S35&36	3300	30 Jun-4 Jul	324	
#Big Therriault Lake, Lincoln Co.	T37N R25W S32	5600	7-10 July	240	
#Divide Creek, Lincoln Co.	T37N R24W S19	5600	7-10 July	252	
Three Rivers District					
*Hawkins Pond, Lincoln Co.	T37N R33W S18	6200	26 July	5	
#Pete Creek Meadow, Lincoln Co.	T37N R33W S13&24	4300	24-27 July	423	
Libby District					
Loon Lake, Lincoln Co.	T33N R32W S24&25	3600	21-25 June	250	200
Rainbow Lake, Lincoln Co.	T33N R31W S6&7	4200	21-25 June	150	240
#Tom Poole Lake, Lincoln Co.	T33N R31W S28	3400	21-25 June	150	200
Tepee Lake, Lincoln Co.	T28N R30W S25	4200	17-21 June	553	3
Cabinet District					
Rock Creek Meadow, Sanders Co.	T26N R31W S6	3800	3-5 Aug	290	
FLATHEAD NATIONAL FOREST					
Tally Lake District					
*Bowen Creek, Lincoln Co.	T31N R26W S1	4760	18-19 Aug	114	
Hellroaring Basin, Flathead Co.	T32N R22W S35	4600	21-23 July	272	
BEAVERHEAD NATIONAL FOREST					
Wisdom District					
Schultz Crk trib., Beaverhead Co.	T1N R17W S31	8100	13-17 July	306	
Schultz Saddle, Beaverhead Co.	T1S R18W S2	7840	13-17 July	404	
Tie Creek meadows, Beaverhead Co.	T1S R18W S2	7360	15-18 July	279	
*Maybe Meadows, Beaverhead Co.	T1S R17W S26	6520	13-15 July	140	
BITTERROOT NATIONAL FOREST					
Sula District					
*Meadow Creek, Ravalli Co.	T1N R18W S10	5920	17-18 July	97	
Grand Total				5160	2308 153

\* = Synaptomys found at this site

# = Plant community survey done at this site

L = Sherman live trap; P = pitfall trap.



Pam Harrington of the MTNHP conducted botanical surveys at 8 trapping sites during 7-12 July 1992 (Appendix B). ECODATA methodology was used for botanical surveys (DeVelice 1991). Additionally, Bonnie Heidel, MTNHP botanist, conducted a brief vegetative survey of the Maybee Meadows site on 24 October 1992.

## RESULTS

Northern Bog Lemming Survey. Northern bog lemmings were captured at 5 (Figure 2) of the 21 sites trapped (Tables 1,2,3). Elevation of the sites where bog lemmings were captured ranged from 4760-6520 feet (1535-2100 m).

Northern bog lemmings were caught either in, or very close to, thick mats of sphagnum moss (Sphagnum spp.). Sphagnum moss seemed to be the most reliable indicator of a potential site. Some sites where bog lemmings were caught had an open overstory of subalpine fir (Abies lasiocarpa) and/or spruce (Picea); others were without a tree component. Bog birch (Betula glandulosa) and/or a dwarf willow (Salix sp.) were present at all sites. At Maybee Meadows the moss hummock habitat was dominated by Sphagnum in the ground cover layer; Carex utricularia in the herbaceous layer; and Salix planifolia in the short shrub layer. Bog lemmings at the Sunday Creek site were caught in two community types: 1) a Salix drummondiana community with only 10% S.d. canopy cover; and 2) a Abies lasiocarpa community, Calamagrostis canadensis phase, with canopy cover of 40% A.l. (overstory) and 60% Betula glandulosa (shrub layer). Moss ground cover was 50-60% and 30-50 cm thick (Appendix B).

Plant community surveys were completed on 8 trapping sites (Table 1, Appendix B). The Sunday Creek site was the only site with bog lemmings which had a plant community survey completed; other lemming sites were located too late in the year for plant community surveys to be scheduled. The remaining four sites where bog lemmings were captured will have plant community surveys completed in 1993.

Snap trap effort required to document bog lemming presence at sites containing the species ranged from a maximum of 140 trap nights (during 2 nights of trapping) down to 5 "trap nights" (120 traps from noon to 1 p.m.). In contrast, areas where no bog lemmings were found received 240-556 trap nights of effort. At sites where northern bog lemmings were captured, we averaged 1.67 lemmings per 100 trap nights. A mixture of Dailey's muskrat lure mixed with peanut butter and oatmeal appeared more effective at capturing northern bog lemmings than other baits used (Table 4), but differences were not significant ( $G = 3.44$ , 3 *df*).

During bog lemming surveys, at least 13 other species of small mammals were captured (Tables 2,3). All Sorex palustris were identified in the field; a few of the smaller Sorex species were also identified and all were Sorex cinereus. The complete inventory of shrew captures (by species) will have to wait for the specimens to be prepared and the skulls keyed out.

Figure 2. Occurrences of Northern bog lemmings in Montana.

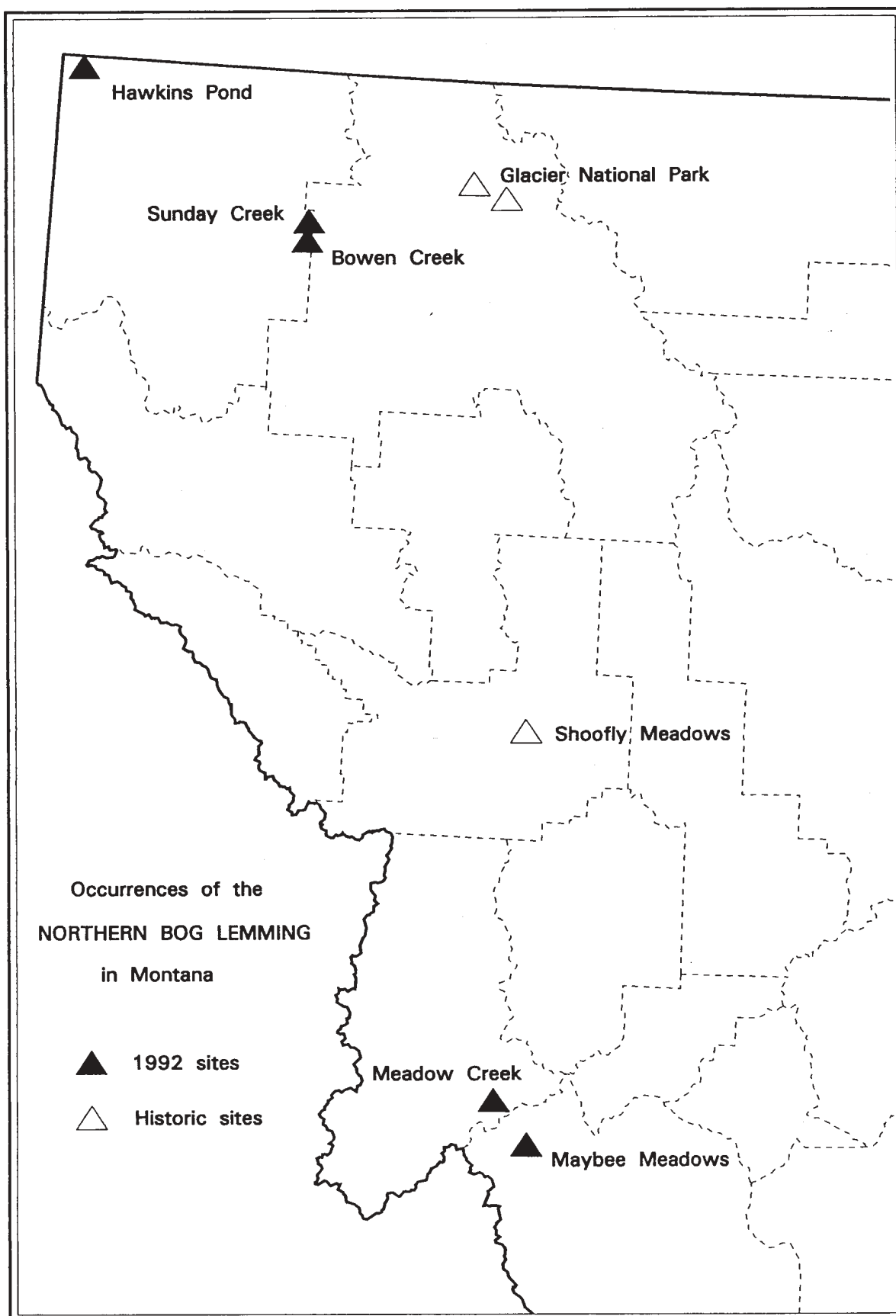


Table 2. Results of snap trapping during 1992 northern bog lemming surveys.

Site	Trap Nights	Total number of each species caught											
		SOPA	SOSP	MILO	MIPE	MIRI	PHIN	SYBO	CLGA	ZAPR	PEMA	TASP	THTA
Bowen Creek	114	0	0	0	2	0	0	1	1	0	0	0	0
Sunday Creek	361	0	10	0	1	0	2	5	1	0	0	0	0
Rock Ck Meadow	290	1	0	0	1	0	0	0	0	3	0	0	0
Hawkins Pond	5	0	0	0	0	0	0	1	0	0	0	2	0
Schultz Ck Trib.	306	0	2	0	10	0	3	0	7	0	0	0	1
Schultz Saddle	404	0	7	0	9	5	6	0	2	0	0	2	0
Tie Ck meadows	279	0	0	0	21	3	7	0	1	0	0	0	0
Meadow Ck	97	0	2	0	1	0	1	1	0	0	0	0	0
Maybee Meadows	140	0	1	0	8	0	4	4	0	0	0	0	0
Hellroaring Bas.	272	0	4	4	13	2	3	0	1	5	6	0	0
Pete Ck Meadow	423	0	3	0	6	0	1	0	1	1	0	11	0
Loon Lake	250	0	3	1	14	0	0	0	0	4	3	1	0
Rainbow Lake	150	0	0	1	0	0	1	0	1	0	0	0	0
Tom Poole Lake	150	0	3	0	27	0	0	0	0	0	0	1	0
Twin Meadows Ck	428	0	16	1	24	0	14	0	7	2	0	0	0
Dudley Slough	387	0	2	0	12	0	12	0	0	0	0	0	0
Ant Flats	288	0	0	0	2	0	0	0	1	0	0	0	0
Jumbo Lake	324	4	3	0	11	0	0	0	5	2	2	0	0
Big Therriault	240	0	7	1	0	0	5	0	3	7	3	1	0
Divide Creek	252	0	8	0	2	0	3	0	31	4	4	0	0
<b>Grand Total</b>	<b>5160</b>	<b>5</b>	<b>71</b>	<b>8</b>	<b>164</b>	<b>10</b>	<b>62</b>	<b>12</b>	<b>62</b>	<b>28</b>	<b>18</b>	<b>18</b>	<b>1</b>

SOPA=Sorex palustris; SOSP=Sorex spp.; SYBO=Synaptomys borealis; MILO=Microtus longicaudus; MIPE=Microtus pennsylvanicus; MIRI=Microtus richardsoni; PHIN=Phenacomys intermedius; CLGA=Clethrionomys gapperi; ZAPR=Zapus princeps; PEMA=Peromyscus maniculatus; TASP=Tamias spp.; THTA=Thomomys talpoides.

Table 3. Results of live trapping during 1992 northern bog lemming surveys (includes pitfalls and Sherman live-traps).

Site	Trap Nights		Total Number of each species caught (including recaptures)												
	Pit.	Sher.	SOSP	MILO	MIPE	PHIN	SYBO	CLGA	ZAPR	PEMA	NECI	MUFR	AMMA	RAPR	BUBO
Sunday Creek															
21-24 July 92	50	477	7	0	0	0	1(1)	3	0	0	0	0	3	0	0
17-21 Aug 92	100	638	18	0	4	0	0(1)	5	0	7	0	1	7	3	10
Loon Lake		200	1	0	4	0	0	0	3	0	0	1	0	0	0
Tepee Lake	3	553	11	5	23	0	0	26	1	4	1	0	0	0	0
Rainbow Lake		240	5	0	0	0	0	0	4	4	0	0	0	0	0
Tom Poole Lake		200	4	0	5	0	0	0	0	0	0	0	0	0	0
Grand Total	153	2308	46	5	36	0	1(2)	34	8	15	1	2	10	3	10

( ) = number of *Synaptomys* caught in a pitfall.

SOSP=*Sorex* spp.; MILO=*Microtus longicaudus*; MIPE=*Microtus pennsylvanicus*; PHIN=*Phenacomys intermedius*; SYBO=*Synaptomys borealis*; CLGA=*Clethrionomys gapperi*; ZAPR=*Zapus princeps*; PEMA=*Peromyscus maniculatus*; NECI=*Neotoma cinerea*; MUFR=*Mustela frenata*; AMMA=*Ambystoma macrodactylum*; RAPR=*Rana pretiosa*; BUBO=*Bufo boreas*.



Table 4. Success of various baits used in snap traps at sites where northern bog lemmings were found in 1992.

Site	<u>*PB &amp; O</u>		<u>Dailey's</u>		<u>D.'s #2</u>		<u>Haw. Musk.</u>	
	T-N	Sybo	T-N	Sybo	T-N	Sybo	T-N	Sybo
Bowen Creek			56	1	58			
Sunday Creek	180	2					181	3
Hawkins Pond	2		2	1				
Meadow Creek	49		48	1				
Maybee Meadows	72	2	68	2				
Grand Total	303	4	174	5	58	0	181	3
#Sybo/100 trap nights	1.32		2.9		0.00		1.7	

\* PB&O = peanut butter and oatmeal; Dailey's = Dailey's muskrat lure, peanut butter and oatmeal; D.'s #2 = Dailey's muskrat lure #2, peanut butter and oatmeal; Haw. Musk. = Hawbaker's muskrat lure, peanut butter and oatmeal; T-N = number of trap nights; Sybo = number of Synaptomys borealis captured.

Additionally, some voles specimens, particularly subadults, will need verification of species when the skulls are cleaned.

At the five sites where bog lemmings were captured, 0-3 other species of voles were also captured (Table 2). These included the meadow vole (Microtus pennsylvanicus), heather vole (Phenacomys intermedius) and red-backed vole (Clethrionomys gapperi). Red-backed voles were captured at higher/drier micro-sites than bog lemmings, in all cases either in a forest habitat or within 10 m of a forest edge. Red-backed voles were not captured in thick sphagnum mats. Heather voles were captured in a variety of upland and riparian habitats. Meadow voles were caught almost exclusively in wet, open habitats. At the two southern sites, both heather and meadow voles were caught with the northern bog lemmings in a mosaic of sedge meadow and sphagnum moss mats. At Bowen Meadows one meadow vole was caught in sphagnum, while no meadow voles were caught snap trapping at either Sunday Creek or Hawkins Pond within the sphagnum areas. We found that snap trap capture rates of all voles in combination (including bog lemmings) were 40% higher at sites where no bog lemmings were captured than at those where they occurred (6.4 vs 4.6 per 100 trap nights). While we did not record numbers of trap-nights per habitat, we observed trapping success in sphagnum habitat to be much lower than in non-sphagnum habitats.

Sunday Creek Live Trapping. During the July 21-24 live trapping at Sunday Creek, one bog lemming was captured in a pitfall at night and

one in a Sherman live-trap during the day. Both died in the traps. While opening pitfalls and setting traps in August, we found several pitfall covers had been knocked off since the July trapping period. One bog lemming had died in a pitfall as a result of this. During the week, one bog lemming was captured in a pitfall, marked and released. Northern bog lemming capture rates for these two periods were: 0.09 per 100 trap nights in Sherman live traps; and 1.33 per 100 trap nights in pitfalls.

In an effort to increase live trap success rates, the bedding material from the bog lemming captured in the pitfall in August was divided and added to 8 Sherman traps (olfactory enticement) in nearby micro-sites with thick sphagnum mats. No additional bog lemmings were captured as a result.

Specimens Collected. A total of 15 northern bog lemmings specimens will be placed in one or more regional university museums (Table 5). All but one will be prepared as skins and skulls/skeletons; one lemming captured in a pitfall was not satisfactory for a skin and will be a skeleton only. Stomachs were collected from 14 specimens and will be analyzed in the next year. Only one female was collected. We noted that droppings from some specimens were bright green, however, at least 2 individuals had brown droppings.

Table 5. Northern bog lemming specimens from 1992.

Site	Date	#	Sex	Type
<hr/>				
Sunday Creek,				
T32N R26W S13	5-Jul	SGB 4	M	Si, Se, St
"	"	SGB 5	M	"
"	6-Jul	SGB 6	M	"
"	7-Jul	SGB 7	M	"
"	"	SGB 8	M	"
"	22-Jul	JDR 3164	M	Si, Se, (St, Ki)
"	17-Aug	to do	?	Se
Maybee Meadows	15-Jul	SGB 9	M	Si, Se, St
T1S R17W S26	15-Jul	SGB 10	M	"
"	15-Jul	SGB 11	M	"
"	15-Jul	SGB 12	F	"
Meadow Creek				
T1N R18W S10	18-Jul	SGB 13	M	Si, Se, St
Hawkins Pond	26-Jul	JDR 3165	M	Si, Se (St, Ki)
T37N R33W S18	"	JDR 3166	M	"
Bowen Creek	19-Aug	to do	M	(Si, Se, St, Ki)
T31N R26W S1				
<hr/>				

Si = Skin

Su = Skull

Se = Skeleton

St = Stomach

Ki = Kidney

## DISCUSSION

Distribution. The Maybee Meadows site is the southern-most site known for the species outside of New England; two sites in New Hampshire are about 160 km farther south (Clough and Albright 1987). The Maybee Meadows site is also the only known northern bog lemming site east of the Continental Divide in Montana. Bog lemmings are now known from across the northwest corner of the state and south through the mountains to near Lost Trail Pass on the Continental Divide. We expect additional populations to be found across western Montana, perhaps as far south as Yellowstone National Park, east to the Rocky Mountain Front, and possibly even in some eastern mountain ranges such as the Belt or Snowy ranges. Elevations from which bog lemmings are now known in Montana, range from 3800 feet (Camas Creek, Wright 1949) up to 6520 feet (Maybee Meadows).

Populations of northern bog lemmings in the northwest U.S. have apparently been isolated since the last ice age ended over 10,000 years ago. It seems likely lemming populations were more wide-spread at that time, then were reduced in size and number during the Hypsithermal 6000-3000 years ago, when the climate was warmer than at the present time.

Habitat. Bog lemmings at Sunday Creek were caught in two community types: 1) a Salix drummondiana community and 2) a Abies lasiocarpa community, Calamagrostis canadensis phase. Moss ground cover was 50-60% and 30-50 cm thick (Appendix B). However, peatland communities

are a very small proportion of the landscape in the region and have not been adequately classified (Bursik and Moseley 1992). It is doubtful that bog lemming distribution will be mirrored by plant community distributions using current definitions.

At our first three new bog lemming sites, all bog lemmings were caught in sphagnum moss mats, despite more traps being placed in other adjacent habitats. This helped us develop a "search image" for additional potential bog lemming populations, and directly contributed to our choices of Bowen Creek and Hawkins Pond as trapping sites. Previous habitat descriptions of S.b. chapmani trapping sites in the northern Rocky Mountains have sometimes included mention of sphagnum moss (Layser and Burke 1973, Groves and Yensen 1989) while others have not (Wright 1950, Weckwerth and Hawley 1962, Wilson et al. 1980). JDR spent several hours along Camas Creek in the vicinity of the first lemming population known from the state (Wright 1950) and found only scattered clumps of moss. Weckwerth and Hawley (1962) did not describe the specific sites where they captured bog lemmings. JDR captured a single juvenile male lemming on a dry alpine/subalpine ridge in northeast Washington (Wilson et al. 1980).

We believe that areas with extensive sphagnum mats are the most likely sites in which to find new bog lemming populations in Montana. Other habitats may support lower densities of bog lemmings; may be

used primarily by dispersing individuals; may be used during specific seasonal, climatic, or competitive situations; or may be population sinks. The only certainty is that there is much to be learned about habitat use by northern bog lemmings.

Research Methods. How do we get the information on distribution, habitat use, and movement we need to manage this species?

Distributional information, and to a lesser extent habitat use, has often been gathered using snap-traps. Detailed habitat use and movement data is most commonly obtained using mark-recapture techniques with live traps. However, for northern bog lemmings, live traps are of very limited usefulness. This is because Sherman live-trap use: 1) is labor intensive throughout the trapping period; 2) has very low success with any bait tried; and 3) results in at least some mortality (the single animal caught died in the trap).

Pitfalls, as live traps: 1) are labor intensive especially during placement; 2) cannot be used in the saturated soil situations commonly encountered in bog lemming habitat; and 3) result in at least some mortality during and between trapping periods. Given these drawbacks, it seems doubtful that live-trapping methods, by themselves, will yield much information on habitat use, population parameters, or home range sizes. Incidental mortalities may be a significant factor over a study long-term enough to yield good information. Additionally, live-trapping to initially find populations will take at least 10 times the effort and cost when

compared to snap-trapping and will still cause some mortality. Given the very low Sherman live-trapping success, negative results for even 1000 trap-nights per site would not give much confidence that lemmings are not present.

Dropping boards may provide one option, but we think differentiating northern bog lemming dropping from other voles will be difficult. Jones and Birney (1988) report that northern bog lemming droppings are bright green while other vole droppings are brown or black. However, we found that at least some bog lemmings had brown droppings. If color alone is used to differentiate the droppings, it may lead to serious biases.

Snap-trapping for bog lemmings was much more successful than live-trapping and only 1 female was captured using this method (at all locations in Montana in 1992). It appears to be the method of choice for initial survey work to find new populations, both from an economic and time-constraint view. Concerns have been expressed that snap-trapping is not a suitable technique to use on a "sensitive species." This argument may have some validity from a public perception point of view, but has little or no biological basis. Voles, including northern bog lemmings, show r-selected traits, eg. rapid development, early reproduction, high reproductive rates, short life span. These are related to the selection pressures of the high natural mortality suffered by voles, which are food for a large number of predatory vertebrates. For example, bog lemmings made up 1-2% of marten (Martes americana) diets in Glacier National Park,



while comprising only 0.2% of small mammals trapped (Weckwerth and Hawley 1962). The current bog lemming populations in Montana have survived thousands of years of isolation, predation by dozens of species, climatic changes, and catastrophic events such as fires. The chances that taking 1-5 individuals from a site would significantly affect the population approaches zero. We believe that the small possibility of a negative effect is far outweighed by the knowledge of the existence of the population. The chances of major negative effects to a undiscovered lemming population taking place due to land management decisions, is far higher. The Sunday Creek population provides an example of how land management decisions may affect bog lemming populations.

Land Management Impacts. The Sunday Creek area seems typical of northern bog lemming populations, with patches of suitable habitat strung out along a drainage. In the past, when one subpopulation was lost, the habitat patch could be recolonized from adjoining subpopulations. Beaver alternately created and destroyed habitat patches along the drainage via flooding with dams, but dispersal from adjacent areas on the drainage provided inhabitants for the new habitat patches. Fires swept through the area, drying out areas to some extent. However, this drying out was probably reduced somewhat by the timber in the stream bottom being more resistant to fire than that on the slopes above. This dynamic process has lasted thousands of years. However, the Sunday Creek population of lemmings may now be in danger of extirpation.

Habitat patches we viewed as "good" appeared to span the length of Sunday Creek from our original lemming capture location (T32N, R26W, center of Section 13) downstream to Harvey Creek (T33N, R25W, Section 25) with gaps of less than 1.5 km between patches. However, from the Sunday Creek crossing at FS 315 (T32N, R26W, Section 6, NE 1/4) downstream, the habitat has been substantially reduced and degraded. In Paul Creek, a tributary of Sunday Creek, this has also occurred. It appears that substantial amounts of good bog lemming habitat occurred in Paul Creek drainage at least for 3 km up from the confluence with Sunday Creek. These bog areas have dried out and much of the habitat now appears marginal. Two management actions appear to have caused the habitat reduction and degradation along Paul Creek and lower Sunday Creek, grazing and timber harvest.

Grazing is very heavy over much of the riparian habitat from the Sunday Creek crossing of FS-315 downstream. Where large acreages apparently had suitable habitat in the past, much of the area has been converted to introduced plants, often eaten down to 1" tall or less. This process can be seen at the few remaining sphagnum patches. Since sphagnum moss and many of the associated sedges appear unpalatable to cattle, the habitat is first damaged by trampling as cattle cross the habitat. These trampled areas allow invasion by exotic plant species. Many of these invaders are eaten by cattle, resulting in more trampling and acceleration of the process. Both soil and hydrology may be changed in a very long-term

fashion, and habitat recovery may be very slow in the short-term (decades) even with total exclusion of cattle and intensive rehabilitation.

Timber harvest has been extensive in the drainage in this area. Clearcuts extend from high up on the valley slope, down onto the flood plain; in some areas no trees remain in the riparian area. Remnant wetland plants are now found in very dry areas. Apparently the heavy removal has changed the timing of the runoff, with a flush of water in spring and little retention into summer. Areas that had access to water or saturated soils nearly all year are now dry by early to mid-summer. Additionally, floodplain areas which had tree cover and thus shading to maintain cool, damp microsites, have been opened up and now dry out quickly.

Timber harvest alone may not eliminate large areas of habitat. However, the cumulative effects of several new factors combined with the changing moisture regime, may eliminate large potential habitat areas over the long-term. Grazing and soil compaction by cattle, coupled with invading plants, is in the process of completely eliminating patches of habitat from section 34 downstream on Sunday Creek (most of which is privately owned land). This would completely isolate habitat in Paul Creek. If bog lemmings were extirpated in Paul Creek it is unlikely they could re-populate it from upper-Sunday Creek.

Minimum patch sizes and possible dispersal distances are not known for bog lemmings. However, we estimate the current suitable

habitat to be less than 50% of what was typical of the drainage prior to the past 50 years. With the reduced habitat, comes increased dispersal distances between patches. Additionally, the large areas with very short vegetation due to overgrazing probably are severe barriers to dispersal.

The habitat at the Meadow Creek lemming site is also being affected by cattle grazing. Suitable bog lemming habitat containing sphagnum moss was estimated to cover about 10 acres, with only sparse, very marginal habitat present downstream for about 3 km and none upstream. Trampling and grazing around the edge of the site has severely degraded at least 1 acre of prime habitat. Much of the soil that once was covered with sphagnum, is now exposed and drying out. Similar but lesser impacts were also observed at Maybee Meadows.

#### **MANAGEMENT RECOMMENDATIONS AND RESEARCH NEEDS**

Based on limited observations at the sites where bog lemmings were found we would make several interim management recommendations. We feel these are the minimum necessary to maintain viable bog lemming populations. Additional research is needed and may suggest other management actions which will be necessary for maintaining viable bog lemming populations.

- 1) Assume northern bog lemmings are present on all National Forests in Montana (except Custer N.F.) during land management planning processes.

- 2) Do not harvest timber within 100 m of sphagnum mats or associated streams and wetlands.
- 3) Minimize domestic livestock grazing in drainages with sphagnum mats present. Range conditions in riparian areas with sphagnum mats should be maintained in good to excellent categories. If current range condition is fair or poor, stocking rates should be reduced to a point where rapid recovery occurs.

Very little information is available on the northern bog lemming. Even the distribution in the U.S. is poorly understood; most populations have been found within the past 15 years. Habitat use by northern bog lemmings has never been determined in any systematic way. Descriptions of habitat in the U.S. consist of anecdotal accounts of where each specimen has been captured; only about 30 individuals had been collected in the Pacific Northwest prior to this study. Food habits and reproductive information also are limited to a very few anecdotal accounts. No information is available on such subjects as movements, population densities, longevity, or home range. Much additional research is required to make intelligent land management decisions where northern bog lemmings are present. We recommend the following as the highest priority needs:

- 1) Develop an annotated bibliography of northern bog lemming literature. The literature should be summarized including

- information on habitat, reproduction, and success of trapping methods. Distribute this information to significant land management agencies in the Pacific Northwest.
- 2) Conduct additional surveys to better understand distribution in Montana. Analyze all stomachs of bog lemmings collected to provide food habits information.
  - 3) Conduct plant community surveys at all known bog lemming locations. This should include identification of dominant mosses present.
  - 4) Gather information on the requirements of the mosses found to be dominant on the bog lemming sites.
  - 5) Carry out research on northern bog lemming habitat use. Given the extreme difficulty in capturing northern bog lemming we feel radio-telemetry is the only viable means to obtain satisfactory answers as to how bog lemmings use habitat within their home ranges.
  - 6) Carry out research on northern bog lemming movements to gather information on home ranges and possibly dispersal. This information needs to be integrated with simultaneously collected habitat use data. Again, we feel radio-telemetry is the only viable methodology available.

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## **APPENDICES**

### **Appendix A. Data Forms**

Data Sheet - Small Mammal Snap Trapping \_\_\_\_ of \_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_ Biologist \_\_\_\_\_

Gen. Location \_\_\_\_\_  
T \_\_\_\_\_ N \_\_\_\_\_ R \_\_\_\_\_ W \_\_\_\_\_ Section \_\_\_\_\_

Weather \_\_\_\_\_  
(Temp., wind dir & speed, cloud cover, precip last 24 hrs)

List all individuals caught under the type of bait used

-----  
Bait \_\_\_\_\_ # Traps \_\_\_\_\_ # Snapped \_\_\_\_\_

-----  
Bait \_\_\_\_\_ # Traps \_\_\_\_\_ # Snapped \_\_\_\_\_

Data Sheet - Small Mammal Live Trapping \_\_\_\_ of \_\_\_\_

Date \_\_\_\_\_ Time \_\_\_\_\_ Biologist \_\_\_\_\_

Gen. Location \_\_\_\_\_

T \_\_\_\_\_ N \_\_\_\_\_ R \_\_\_\_\_ W \_\_\_\_\_ Section \_\_\_\_\_

Weather \_\_\_\_\_

(Temp., wind dir & speed, cloud cover, precip last 24 hrs)

Species \_\_\_\_\_ Alive/Dead? \_\_\_\_\_

Grid/Trap # \_\_\_\_\_ Trap type \_\_\_\_\_ Bait \_\_\_\_\_

Sex \_\_\_\_\_ Repro. \_\_\_\_\_  
(scrotal, perforate, lactating, etc)

Wt. \_\_\_\_\_ Tot. Len. \_\_\_\_\_ Tail len. \_\_\_\_\_ Ear L. \_\_\_\_\_

Hind Ft. Len. \_\_\_\_\_ Marked today? \_\_\_\_\_

MARKING: Front \_\_\_\_\_ Rear \_\_\_\_\_  
(ie. RF3) (ie. LH2)

Species \_\_\_\_\_ Alive/Dead? \_\_\_\_\_

Grid/Trap # \_\_\_\_\_ Trap type \_\_\_\_\_ Bait \_\_\_\_\_

Sex \_\_\_\_\_ Repro. \_\_\_\_\_

Wt. \_\_\_\_\_ Tot. Len. \_\_\_\_\_ Tail len. \_\_\_\_\_ Ear L. \_\_\_\_\_

Hind Ft. Len. \_\_\_\_\_ Marked today? \_\_\_\_\_

MARKING: Front \_\_\_\_\_ Rear \_\_\_\_\_

Species \_\_\_\_\_ Alive/Dead? \_\_\_\_\_

Grid/Trap # \_\_\_\_\_ Trap type \_\_\_\_\_ Bait \_\_\_\_\_

Sex \_\_\_\_\_ Repro. \_\_\_\_\_

Wt. \_\_\_\_\_ Tot. Len. \_\_\_\_\_ Tail len. \_\_\_\_\_ Ear L. \_\_\_\_\_

Hind Ft. Len. \_\_\_\_\_ Marked today? \_\_\_\_\_

MARKING: Front \_\_\_\_\_ Rear \_\_\_\_\_

NOTES:

Species\_\_\_\_\_ Alive/Dead?\_\_\_\_\_  
Grid/Trap #\_\_\_\_\_ Trap type\_\_\_\_\_ Bait\_\_\_\_\_  
Sex\_\_\_\_\_ Repro.\_\_\_\_\_  
(scrotal, perforate, lactating, etc)

Wt.\_\_\_\_\_ Tot. Len.\_\_\_\_\_ Tail len.\_\_\_\_\_ Ear L.\_\_\_\_\_  
Hind Ft. Len.\_\_\_\_\_ Marked today?\_\_\_\_\_

MARKING: Front\_\_\_\_\_ Rear\_\_\_\_\_  
(ie. RF3) (ie. LH2)

-----  
Species\_\_\_\_\_ Alive/Dead?\_\_\_\_\_  
Grid/Trap #\_\_\_\_\_ Trap type\_\_\_\_\_ Bait\_\_\_\_\_

Sex\_\_\_\_\_ Repro.\_\_\_\_\_  
Wt.\_\_\_\_\_ Tot. Len.\_\_\_\_\_ Tail len.\_\_\_\_\_ Ear L.\_\_\_\_\_  
Hind Ft. Len.\_\_\_\_\_ Marked today?\_\_\_\_\_

MARKING: Front\_\_\_\_\_ Rear\_\_\_\_\_  
-----

Species\_\_\_\_\_ Alive/Dead?\_\_\_\_\_  
Grid/Trap #\_\_\_\_\_ Trap type\_\_\_\_\_ Bait\_\_\_\_\_

Sex\_\_\_\_\_ Repro.\_\_\_\_\_  
Wt.\_\_\_\_\_ Tot. Len.\_\_\_\_\_ Tail len.\_\_\_\_\_ Ear L.\_\_\_\_\_  
Hind Ft. Len.\_\_\_\_\_ Marked today?\_\_\_\_\_

MARKING: Front\_\_\_\_\_ Rear\_\_\_\_\_  
-----

Species\_\_\_\_\_ Alive/Dead?\_\_\_\_\_  
Grid/Trap #\_\_\_\_\_ Trap type\_\_\_\_\_ Bait\_\_\_\_\_

Sex\_\_\_\_\_ Repro.\_\_\_\_\_  
Wt.\_\_\_\_\_ Tot. Len.\_\_\_\_\_ Tail len.\_\_\_\_\_ Ear L.\_\_\_\_\_  
Hind Ft. Len.\_\_\_\_\_ Marked today?\_\_\_\_\_

MARKING: Front\_\_\_\_\_ Rear\_\_\_\_\_  
-----

NOTES:

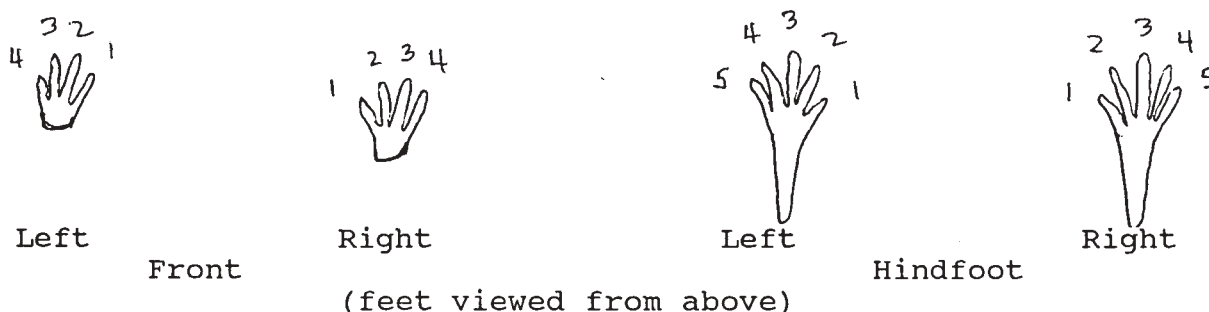
LOCATION \_\_\_\_\_  
 DATES \_\_\_\_\_

# Instructions for filling in Small Mammal Data Sheet

Indicate number of sheets used for this checking session

Date: Use formate 13 Jun 92      Time: Use formate 0930  
 Weight: in grams (or tenths of grams)  
 Total Length: in mm from nose tip to tail vertebra tip with animal stretched on dorsal side  
 Tail length: in mm from where tail enters body to tip of tail vertebra (hold tail at right angle (up) from body)  
 Ear length: in mm from the deepest part of the notch to tip of ear pinna  
 Hind foot length: in mm from heel bone to end of longest toenail  
 Reproduction: 1) males: testes scrotal or inguinal; 2) females: perforate or imperforate; if perforate, lactating or not and nipple size.

Marking with toe clipping:



LF1 RH1	LF1 LH1	RF1 RH1	RF1 LH1
LF1 RH2	LF1 LH2	RF1 RH2	RF1 LH2
LF1 RH3	LF1 LH3	RF1 RH3	RF1 LH3
LF1 RH4	LF1 LH4	RF1 RH4	RF1 LH4
LF1 RH5	LF1 LH5	RF1 RH5	RF1 LH5
LF2 RH1	LF2 LH1	RF2 RH1	RF2 LH1
LF2 RH2	LF2 LH2	RF2 RH2	RF2 LH2
LF2 RH3	LF2 LH3	RF2 RH3	RF2 LH3
LF2 RH4	LF2 LH4	RF2 RH4	RF2 LH4
LF2 RH5	LF2 LH5	RF2 RH5	RF2 LH5
LF3 RH1	LF3 LH1	RF3 RH1	RF3 LH1
LF3 RH2	LF3 LH2	RF3 RH2	RF3 LH2
LF3 RH3	LF3 LH3	RF3 RH3	RF3 LH3
LF3 RH4	LF3 LH4	RF3 RH4	RF3 LH4
LF3 RH5	LF3 LH5	RF3 RH5	RF3 LH5
LF4 RH1	LF4 LH1	RF4 RH1	RF4 LH1
LF4 RH2	LF4 LH2	RF4 RH2	RF4 LH2
LF4 RH3	LF4 LH3	RF4 RH3	RF4 LH3
LF4 RH4	LF4 LH4	RF4 RH4	RF4 LH4
LF4 RH5	LF4 LH5	RF4 RH5	RF4 LH5

## **Appendix B. Element Occurrence Records**

SYNAPTOMYS BOREALIS \* 002  
NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Survey site name: HAWKINS POND  
EO rank: B  
EO rank comments: QUALITY GOOD; SIZE SMALL BUT MAY CONTINUE  
DOWNSTREAM.

County: LINCOLN

USGS quadrangle: NORTHWEST PEAK

Township: Range: Section: TRS comments:  
037N 033W 18 SE4NE4

Survey date: 1992-07-26 Elevation: 6190  
First observation: 1992-07-26 Slope/aspect: LEVEL  
Last observation: 1992-07-26 Size (acres): 8

Location:

PURCELL MOUNTAINS; FROM YAAK TAKE FS RD 338 ~20 MI TO SITE.

Element occurrence data:

~10 SEEN; A LOT OF SIGN (CUTTINGS, DROPPINGS, RUNWAYS). 1 CAUGHT BY  
HAND; SCROTAL MALE TRAPPED.

General site description:

POND AREA FILLING IN; OPENING IN SUBALPINE FIR FOREST. GROUND COVER  
ABOUT 50% SPHAGNUM MOSS WITH SEDGES AND SCATTERED DWARF SALIX SP.  
REST, SEDGE MEADOW, FLOODED IN SPRING. SCATTERED LOGS. ZAPUS PRINCEPS  
ALSO OBSERVED.

Land owner/manager:

KOOTENAI NATIONAL FOREST, THREE RIVERS RANGER DISTRICT

Comments:

Information source:

Reichel, J.D. and S.G. Beckstrom. 1993. Northern bog lemming survey:  
1992. [Unpublished report] Montana Natural Heritage Program. Helena,  
MT. 59620.

Specimens:

REICHEL, J.D. (3165 and 3166). 1992.

SYNAPTOMYS BOREALIS \* 003  
NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Survey site name: MAYBEE MEADOWS  
EO rank: A  
EO rank comments: QUALITY EXCELLENT; LARGE SIZE; HABITAT  
PATCHES UP AND DOWNSTREAM.

County: BEAVERHEAD

USGS quadrangle: BIG HOLE BATTLEFIELD

Township: Range: Section: TRS comments:  
001S 017W 26 NW4SW4

Survey date: 1992-07-15 Elevation: 6520  
First observation: 1992-07-15 Slope/aspect: LEVEL  
Last observation: 1992-07-15 Size (acres): 30

Location:

ANACONDA RANGE; FROM WISDOM TAKE HWY 43 W. 13 MI. TO FS RD 1203; TURN  
RIGHT AND GO N. ~7 MI.

Element occurrence data:

4 TRAPPED, INCLUDING 3 AD. (SCROTAL) M. AND 1 F. W/ 3 EMBRYOS.

General site description:

MEADOW AREA SURROUNDED BY LODGEPOLE PINE. UPPER MEADOW WET W/  
SPHAGNUM MOSS MATS, SALIX PLANIFOLIA, BOG BIRCH AND CAREX  
UTRICULARIA. LOWER MEADOW W/ SEDGES, SALIX DRUMMONDIANA, AND MUCH  
DRYER; LOWER MEADOW BADLY OVERGRAZED BY CATTLE. SHRUBS IN BOG AREA  
HEAVILY GRAZED BY DEER/ELK IN WINTER.

Land owner/manager:

BEAVERHEAD NATIONAL FOREST, WISDOM RANGER DISTRICT

Comments:

Information source:

Reichel, J.D. and S.G. Beckstrom. 1993. Northern bog lemming survey:  
1992. [Unpublished report] Montana Natural Heritage Program. Helena,  
MT. 59620.

Specimens:

BECKSTROM, S. (9-12). 1992.



SYNAPTOMYS BOREALIS \* 004  
NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Survey site name: MEADOW CREEK  
EO rank:  
EO rank comments:

County: RAVALLI

USGS quadrangle: SCHULTZ SADDLE

Township: Range: Section: TRS comments:  
001N 018W 10 S2NE4

Survey date: 1992-07-18 Elevation: 5920  
First observation: 1992-07-18 Slope/aspect: LEVEL  
Last observation: 1992-07-18 Size (acres): 10

Location:

ANACONDA RANGE; FROM SULA GO E. 12 MI. ON FS RD 101 TO FS RD 725;  
TURN RIGHT AND GO S. 6 MI. TO SITE.

Element occurrence data:

General site description:

BOG AREA SURROUNDED BY SEDGES AND TALL SALIX SPP. CREEK RUNS ALONG  
WEST EDGE, BEAVER PONDS ON NORTH, ROAD TO THE EAST. SPHAGNUM MAT ~10  
ACRES.

Land owner/manager:

BITTERROOT NATIONAL FOREST, SULA RANGER DISTRICT

Comments:

Information source:

Reichel, J.D. and S.G. Beckstrom. 1993. Northern bog lemming survey:  
1992. [Unpublished report] Montana Natural Heritage Program. Helena,  
MT. 59620.

Specimens:

BECKSTROM, S. (13). 1992.

SYNAPTOMYS BOREALIS \* 005  
NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Survey site name: BOWEN CREEK FEN  
EO rank: A  
EO rank comments: QUALITY EXCELLENT; LARGE SIZE; HABITAT  
PATCHES UPSTREAM.

County: LINCOLN

USGS quadrangle: DUNSIRE POINT

Township: Range: Section: TRS comments:  
031N 026W 1 SW4NW4

Survey date: 1992-08-19 Elevation: 4760  
First observation: 1992-08-19 Slope/aspect: LEVEL  
Last observation: 1992-08-19 Size (acres): 20

Location:  
SALISH MOUNTAINS; FROM WHITEFISH TAKE HWY 93 NW 17 MI. TO FS RD 60;  
TURN LEFT AND GO W ~19 MI TO SITE.

Element occurrence data:  
TRAPPED 1 MALE; LITTLE SIGN.

General site description:  
LARGE WET SPHAGNUM BOG SURROUNDED BY SUBALPINE FIR AND LODGEPOLE  
PINE. CAREX DOMINANT ON SPHAGNUM. MAJOR SHRUBS ARE DWARF SALIX AND  
BOG BIRCH.

Land owner/manager:  
FLATHEAD NATIONAL FOREST, TALLY LAKE RANGER DISTRICT

Comments:

Information source:  
Reichel, J.D. and S.G. Beckstrom. 1993. Northern bog lemming survey:  
1992. [Unpublished report] Montana Natural Heritage Program. Helena,  
MT. 59620.

Specimens:

SYNAPTOMYS BOREALIS \* 006  
NORTHERN BOG LEMMING

Global rank: G5 Forest Service status: SENSITIVE  
State rank: S2 Federal Status:

Survey site name: SUNDAY CREEK  
EO rank: B  
EO rank comments: QUALITY GOOD; HABITAT PATCHES DOWNSTREAM.

County: LINCOLN

USGS quadrangle: SUNDAY MOUNTAIN

Township: Range: Section: TRS comments:  
032N 026W 13 SE4NW4

Survey date: 1992-07-07 Elevation: 4800  
First observation: 1992-07-05 Slope/aspect: LEVEL  
Last observation: 1992-08-20 Size (acres): 4

Location:  
SALISH MOUNTAINS; FROM STRYKER TAKE FS RD 315 SW ~15 MI. TO CREEK  
CROSSING JUST PAST FS RD 3520 INTERSECTION.

Element occurrence data:  
8 TRAPPED INCLUDING SCROTAL AND JUVENILE MALES. SOME SIGN (RUNWAYS,  
CUTTINGS).

General site description:  
MEADOW ALONG CREEK IN SUBALPINE FIR FOREST W/ ABANDONED BEAVER DAMS  
AND PONDS. SALIX DRUMMONDIANA AND CAREX NEAR WATER'S EDGE. SLIGHTLY  
HIGHER IS SPHAGNUM W/ BOG BIRCH GRADING INTO FOREST.

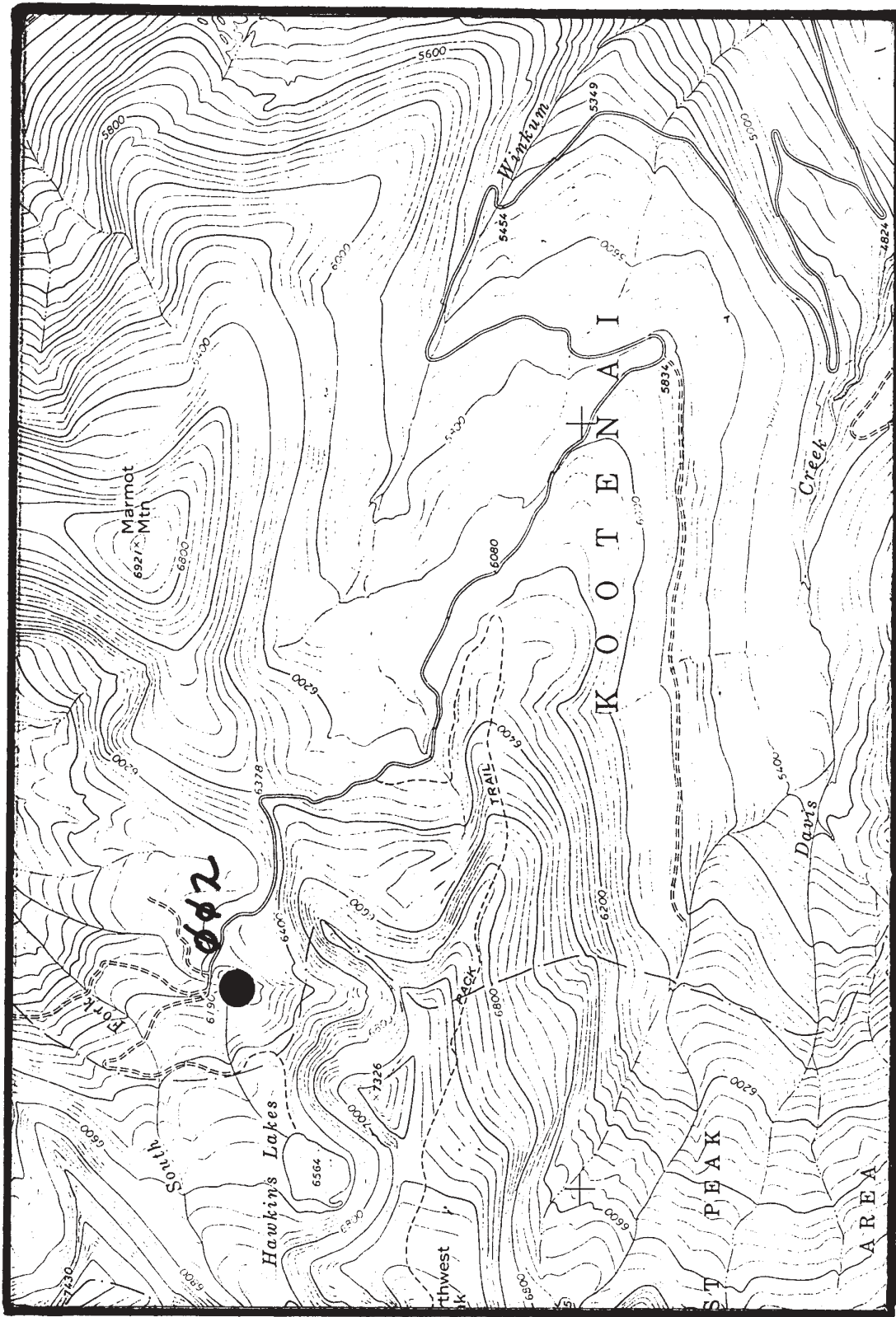
Land owner/manager:  
KOOTENAI NATIONAL FOREST, FORTINE RANGER DISTRICT

Comments:

Information source:  
Reichel, J.D. and S.G. Beckstrom. 1993. Northern bog lemming survey:  
1992. [Unpublished report] Montana Natural Heritage Program. Helena,  
MT. 59620.

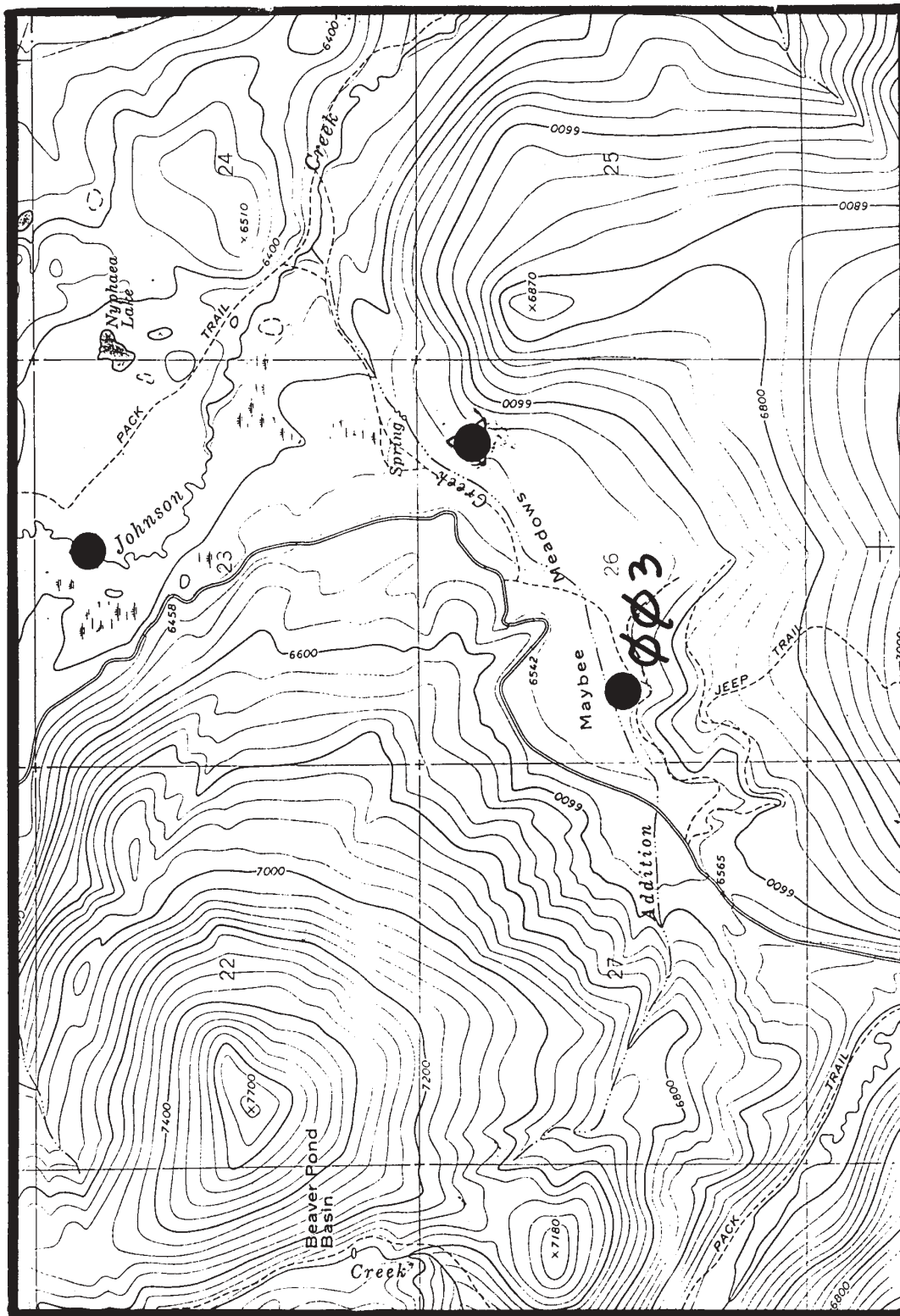
Specimens:  
BECKSTROM, S. (4-8). 1992. REICHEL, J. (3164). 1992.

## Appendix C. Maps of Northern Bog Lemming Sites



USGS Northwest Peak (7.5')  
Synaptomys borealis

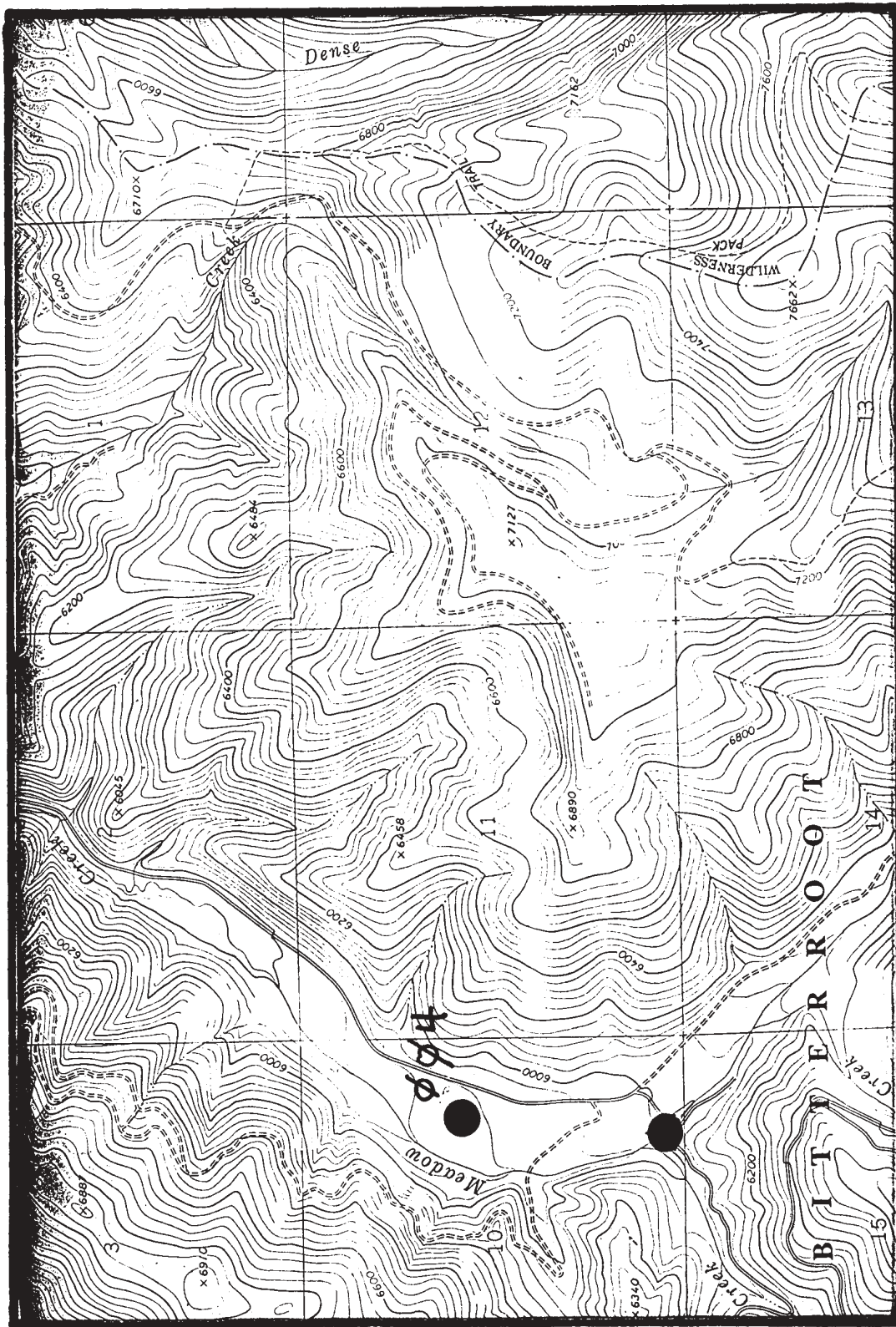
Hawkins Pond (002)



USGS Big Hole Battlefield (7.5')  
Synaptomys borealis

Maybe Meadows (003)



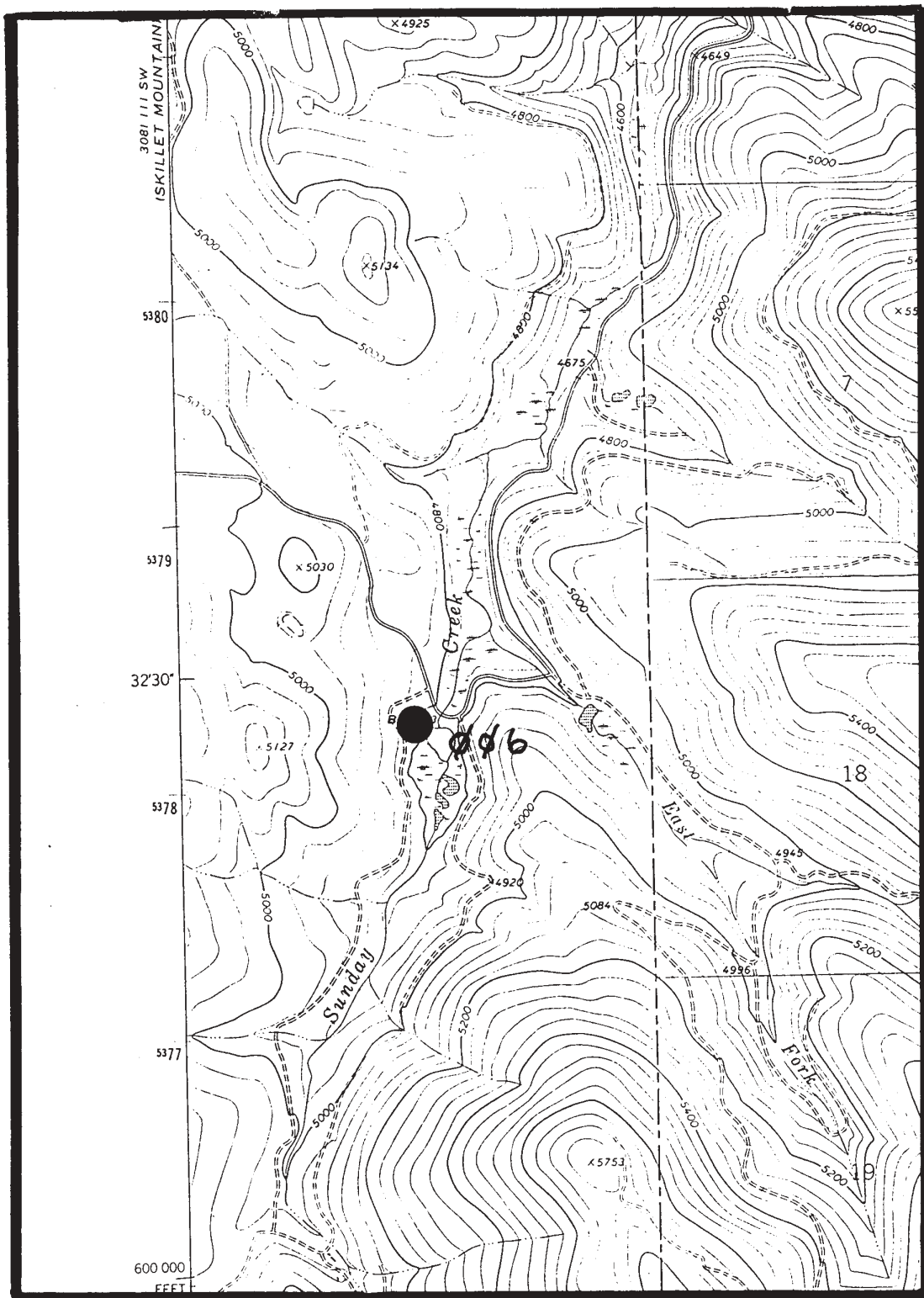


USGS Schultz Saddle (7.5')  
Synaptomys borealis

Meadow Creek (004)







USGS Sunday Mountain (7.5')  
Synaptomys borealis

Sunday Creek (006)

## Appendix D. Botanical Community Surveys